New Zealand’s infrastructure networks are becoming increasingly interconnected and dependent on each other for normal operation. While typically studied as isolated systems, disruptions can rapidly propagate across networks with widespread effects for both society and the economy. It is the nature and magnitude of these dependencies which are generally not well understood.

With interactions between separate networks and a common reliance on electricity supply, the wider transportation sector and electricity distribution networks have been identified as having major potential as contributors to cascading failures. Through a system-of-systems based analysis, this paper presents the dependencies between electricity and passenger transportation networks comprising: airports, ferries, rail, and petroleum distribution across the State Highway (SH) network.

Spatial representations of those selected infrastructures are presented in Fig. 1 as separate networks of nodes and edges, i.e. ferry terminals and routes, rail stations and tracks, and airports and flight connections. Fuel and electricity networks are represented through multi-level hierarchal structures where petrol stations are dependent on bulk fuel distribution points via the shortest path routes across the SH network of roads and crossings, and lower voltage distribution substations are dependent on transmission substations allowing complete network connectivity.

Further functional dependencies are mapped between electricity dependent transportation nodes and edges based on the known or the geographically closest substation of an appropriate voltage, thus creating a network-of-networks.

The criticality of each asset is assumed equivalent to the summed number of users directly and indirectly affected by the failure of each network component. Directly affected users are assigned according to operator provided counts if made available; or where commercially sensitive, estimated using a range of publically available statistics, passenger loadings, and the proximity to an asset. Indirectly affected users are then determined through inter and intra-network connections.

In applying this interdependent network structure, those electricity and passenger transportation assets with the greatest disruptive potential to business-as-usual can be identified while examining system level dependencies on electricity supply.